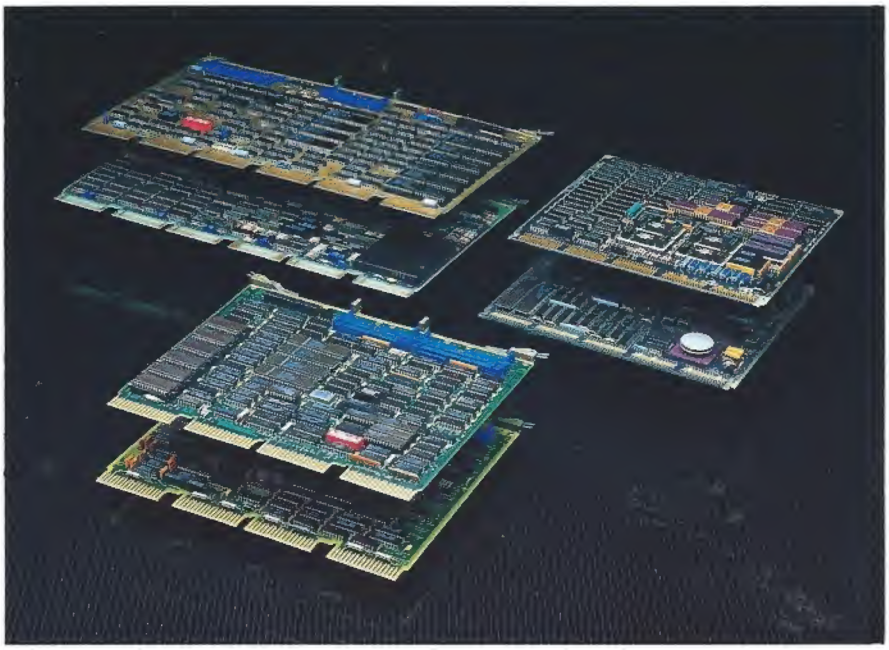
# SDI Disk Controllers

Intelligent Controllers for RA-series Drives

digital



**SDI Controller Family Maximizes Performance and Configuration Flexibility**
Digital's family of intelligent disk controllers reduces computer system overhead while maximizing I/O performance and data reliability for RA-series disk drives and Storage Arrays.

Utilizing high-speed LSI technology and microprocessor logic, SDI controllers relieve the host CPU of disk I/O control functions. Even under heavy loading, these intelligent controllers increase throughput by means of built-in performance optimizations such as seek ordering, minimized rotational latency, and overlapped seeks – all without requiring a single host CPU cycle.

To ensure data integrity and availability, the SDI controllers contain extensive diagnostics as well as microcode for error detection, error correction, and bad block replacement.

Designed as part of the Digital Storage Architecture (DSA) and Standard Disk Interconnect (SDI), the SDI controllers are backed by a one-year warranty and the Digital service organization.

## Highlights

- High-speed microprocessor-based disk controllers perform data handling, error detection and correction, and performance optimizations. The result is a leading I/O-per-second rate necessary for today's I/O-intensive applications and multiuser environments.
- Digital Storage Architecture (DSA) means device-independence for easy expansion, more economical use of your system resources, and minimal dependence on your CPU for I/O functions.
- The Standard Disk Interconnect (SDI) provides greater configuration flexibility. Each controller can support up to four RA-series disk drives or four RA component drives in a storage array.
- Industry-leading error correction code and error detection code ensure data availability and integrity through bad block replacement and automatic revectoring to replacement.
- SDI controllers are backed by a one-year warranty and the Digital service organization, ensuring maximum quality and uptime.
- Recent microcode enhancements in the KDA50 and KDB50 controllers provide up to 60 percent performance increases in applications optimized for maximum bandwidth.

## An SDI Disk Controller for Every Digital System

**UDA50 Unibus Disk Controller**

The UDA50 controller is a two-board controller that interfaces up to four RA-series disk drives or four RA component drives in a storage array. The UDA50 is mounted in a PDP-11 or VAX UNIBUS backplane or expansion box. The UDA50 utilizes data and command buffering for faster throughput and also employs the SDI performance optimizations.

**KDA50 Q-bus Disk Controller**

The KDA50 controller brings the special advantages of Digital Storage Architecture (DSA) and Standard Disk Interconnect (SDI) to Q-bus systems. The KDA50 consists of two modules, the microprocessor module and the SDI module, which mount in a Q-bus backplane and provide a throughput of greater than 1 Mbyte per second. Like the other SDI controllers, the KDA50 employs a range of performance optimizations that are especially important for MicroVAX applications. One KDA50 disk controller can control up to four RA-series disk drives or four RA component drives in a storage array.

Recent enhancements to the KDA50 microcode typically provide a 10 percent performance improvement for transfer sizes in the 4-to-8-Kbyte range found in most VMS applications. Improvements of up to 50 percent can be seen in applications optimized for maximum bandwidth.

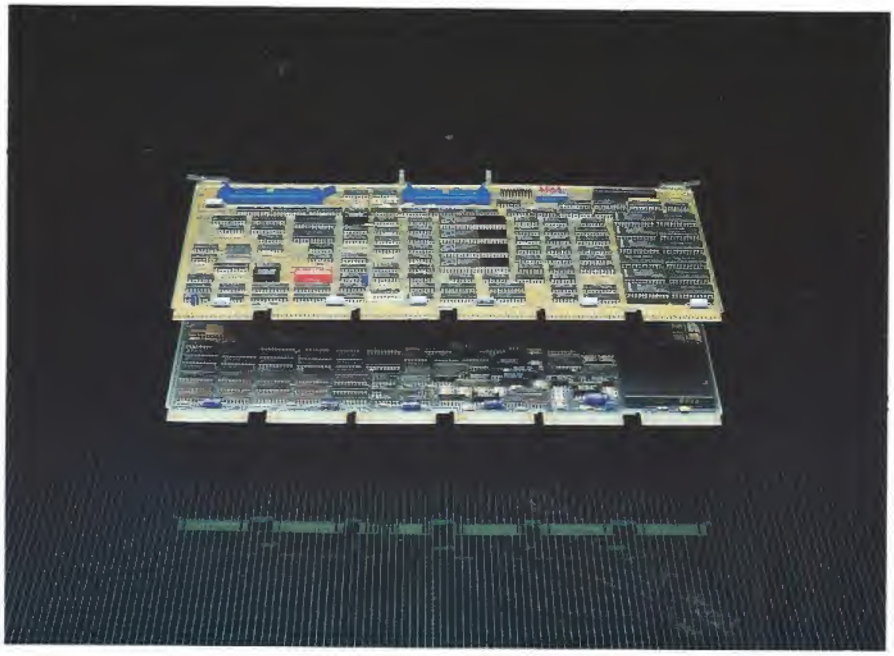
**KDB50 VAXBI Disk Controller**
The KDB50 provides the best in storage technology in terms of capacity and data integrity with a throughput rate of greater than 1 Mbyte per second.

The KDB50 is a two-board controller that interfaces to the high-performance, 32-bit VAXBI, thereby providing greater throughput potential in applications where large amounts of data are transferred between disks and host memory. Like the other members of the family, the KDB50 can control up to four RA-series disk drives or four RA component drives in a storage array.

Recent enhancements to the KDB50 microcode typically provide a 5 percent performance improvement for transfer sizes in the 4-to-8-Kbyte range found in most VMS applications. Improvements of up to 60 percent can be seen in applications optimized for maximum bandwidth.

## DSA Puts the Work on the Controller – Freeing the CPU

The SDI controller family conforms to the Digital Storage Architecture (DSA), the proven design standard for mass-storage products. DSA eliminates the need for the operating system to support every unique storage device with its own device driver.



*UDA50*

Instead, the operating system and controller communicate through a standard protocol, the Mass Storage Control Protocol (MSCP). With this protocol, Digital controllers can offload many of the storage-related activities commonly performed by the host system. The CPU is relieved of disk I/O control functions and is freed for application-oriented tasks. The result is improved overall system performance.

## SDI Means Greater Disk Availability and Less Interdependence

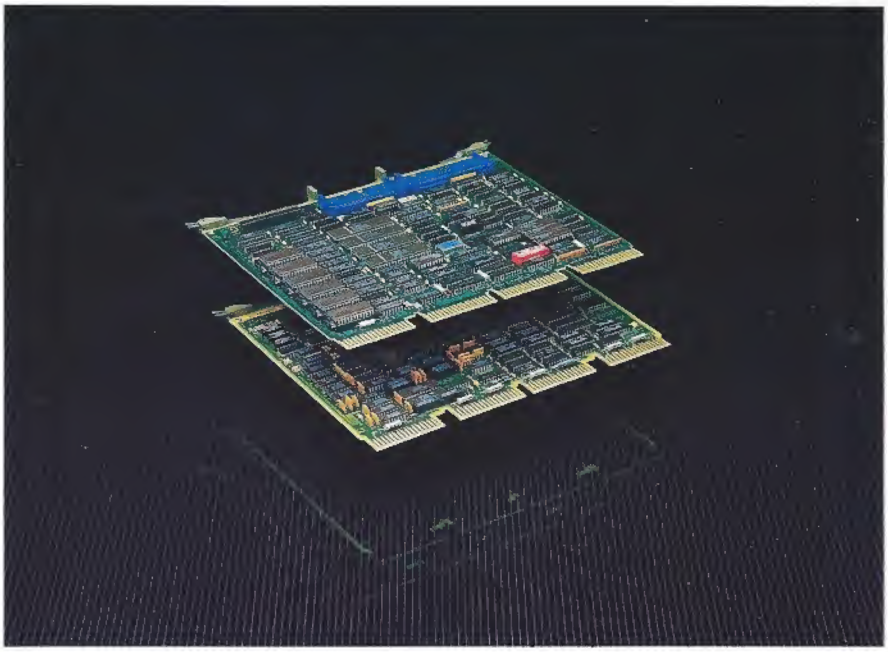
The Standard Disk Interconnect (SDI) is a serial bus that connects each drive directly to the controller in a radial arrangement. As a result, device-interdependencies that can occur in daisychain interconnection layouts are eliminated.

Each disk drive is connected by cable to a separate port on the SDI controller. The controller services each port independently and with equal priority. If one drive is unavailable, communication between the controller and the other drives is unaffected.

Although the three different SDI disk controllers are designed to serve three different system environments, the hardware architecture of all three controllers is similar – two microprocessors operating as a closely coupled multiprocessor. The microprocessors share a common arithmetic and logic unit and communicate through shared memory.

The "upper" microprocessor or port server performs all transactions with the host computer, including MSCP packet and block data movement. The "lower" microprocessor or drive server issues SDI drive control commands and moves data between drives and control buffers by converting parallel data to serial data and vice versa. The lower processor also supports controller optimizations.

This design decouples drive-controller data movement from controller-host data movement. In so doing, the design promotes configuration flexibility because it not only permits wide variations between host computer bandwidth and drive transfer rates but it also eliminates realtime dependency on the host computer bus.



*KDA50*

**Safeguarding Data Integrity**

Because of their industry-leading error detection and recovery capabilities, SDI controllers virtually eliminate the likelihood of losing data. SDI controllers employ the following features to protect your data:

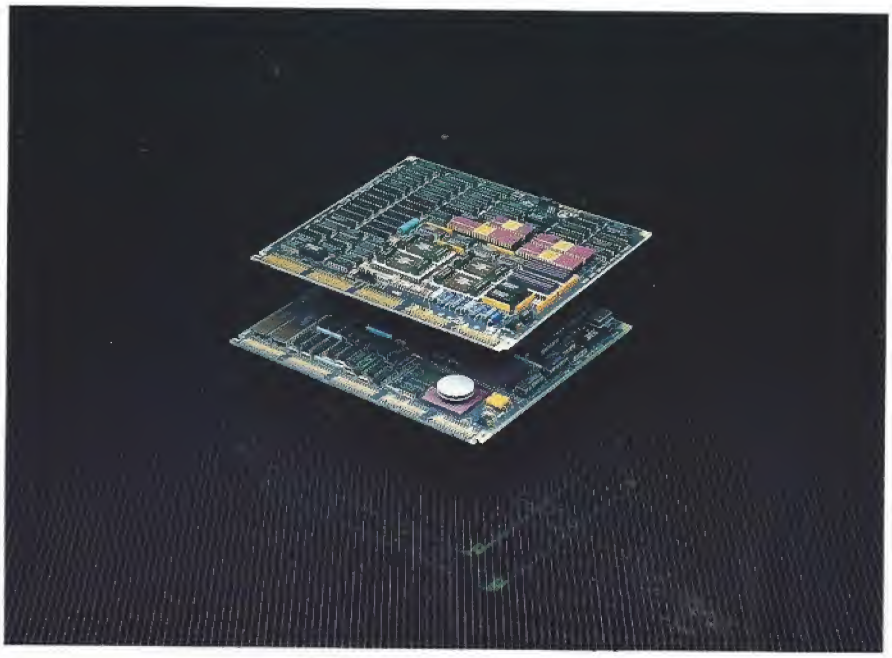
- Error correction code (ECC) – SDI controllers use one of the most extensive error correction codes in the industry today. A 170-bit Reed-Solomon ECC can correct up to eight 10-bit bursts in a single sector, compared to the single 11-bit burst correction of the commonly used 32-bit ECC.
- Error detection code (EDC) – This unique feature of all SDI subsystems verifies ECC computational logic and the ECC correction process, checks controller data paths, and sends a message if data cannot be delivered correctly.
- Bad block replacement (BBR) – Each SDI controller and RA-drive combination employs error thresholds to anticipate media defects, and can request replacement of suspect blocks before any user data is lost. The data is copied to a replacement block, and all future requests for that data are automatically redirected to that location. In addition, the user experiences no shrinkage in available formatted capacity over time. (The bad block replacement feature requires operating system support; revectoring does not. Check appropriate SPDs for versions and releases.)

- Quadruplicate headers – SDI controllers use sector headers to guarantee that the correct data is accessed. Multiple headers allow the controller to survive errors in the header area and prevent loss of data.
- Detection of single failure points – To prevent erroneous data from being passed to the user, SDI controllers are capable of detecting and isolating single-point failures.

**Intelligence Enables SDI Disk Controllers to Work Smart and Fast**

The performance of disk subsystems is crucial with today's I/O-intensive applications such as transaction processing and finite-element analysis. In these environments as well as in heavily loaded multiuser systems, I/O requests often occur faster than they can be executed. To provide the highest-performance I/O-throughput rate, SDI disk controllers optimize subsystem performance in three ways:

- Seek ordering. For most applications, seeking is the largest component of overall disk I/O time. Because greater seek distance equals greater seek time, minimizing seek distance tends to minimize seek time for a given application. The SDI controllers order and execute seek requests in the most efficient sequence possible. The result is significantly improved subsystem performance.
- Maximum seek overlapping. SDI controllers perform all communications of brief duration before beginning a data transfer, first initiating parallel seeks to all disks with I/O requests. That way, one drive can perform a data transfer while other drives are seeking.



*KDB50*

- Rotational optimization. By dynamically allocating the data-transfer path to the drive that is able to use it soonest, SDI controllers minimize the average rotational latency of the subsystem. SDI controllers select the drive that has the requested data closest to its read/write heads to be the next to transfer data. Even for long transfers, rotational optimization increases overall system throughput significantly.

**Repairs Are Fewer and Faster with Onboard Diagnostics**

SDI disk controllers come equipped with extensive onboard diagnostics and utilities. They're designed to accurately identify any failing component – be it module or cable – and allow prompt replacement. As a result, SDI controllers help reduce costly system downtime.

Each time the SDI controller is poweredup, onboard diagnostic microcode executes. Device initialization diagnostics check all SDI controller functions before any devices are accessed. During normal I/O operations, SDI disk controllers continuously verify proper function by memory parity checking, software sanity checking, and protocol validity checking.

Any faults that occur are reported to the host system and logged in host system error logs. In addition, faults are registered in SDI controllers through the illumination of a set of four LEDs located on the controller. The fault pattern is translated into an

error code that can be used to determine the appropriate corrective action. Because SDI controllers utilize Field Replacable Units (FRUs), replacement is fast, maintenance costs are lower, and you experience less system downtime.

## Opening a New Range of Storage Options

The family of SDI disk drives is always expanding, giving you increasing configuration options. Today, you have a range of RA-series disk drives to choose from, as well as RA-based storage arrays – all of which can be controlled by the SDI disk controllers.

The modular packaging design of SDI drives and storage arrays enables you to start with as much storage capacity as you need now. You can easily add more storage later. Because the drives are radially connected to the controller, you can add units without recabling existing drives and without interrupting your system.

A single SDI controller can connect a total of four RA-series drives or four RA component drives in a storage array, giving you the configuration flexibility and capacity to match your application needs.

**Table 1 UDA50 Specifications**

| | |
|---|---|
| **Performance** | |
| Steady-state throughput | 750 Kbyte/s (max.) |
| No. of drives supported | Four, or up to four RA component drives in a storage array |
| **Power Requirements** | |
| Power consumed | 81.6 W (nominal) |
| Steady-state current* | 12.0 A at 5 Vdc (max.)<br>0.04 A at 15 Vdc (max.)<br>1.4 A at −15 Vdc (max.) |
| **Operational Environment** | |
| Temperature range | 10 to 40°C (50 to 104°F) |
| Relative humidity | 10 to 90%, noncondensing |
| Max wet bulb temperature | 28°C (82°F) |
| Min. dew point temperature | 2°C (36°F) |
| Heat dissipation | 259 kJ/h (246 Btu/h), nominal |
| Altitude, max. | 2,438 m (8,000 ft) |
| Operating for altitude | 1.8°C per 1,000 m (1°F per 1,000 ft) above sea level |
| **Physical Characteristics** | |
| UNIBUS loads | 4.3 ac, 1.0 dc |
| Mounting restrictions | Mounts in two hex-height UNIBUS SPC slots in the CPU box or in the following UNIBUS boxes: BA11, BA11-A, BA11-K, BA11-L |

*A 2.0 A at −15Vdc surge during power-on must be allowed for by the use of, for example, a slow-blow fuse or circuit breaker.

**Table 2 KDA50 Specifications**

| | |
|---|---|
| **Performance** | |
| Steady-state throughput | 1.15 Mbyte/s (max.) |
| No. of drives supported | Four, or up to four RA component drives in a storage array |
| **Power Requirements** | |
| Power consumed | 67.9 W (max.) |
| Steady-state current | 13.5 A at 5 Vdc (max.)<br>0.04 A at 12 Vdc (max.) |
| **Operational Environment** | |
| Temperature range | 10 to 40°C (50 to 104°F) |
| Relative humidity | 10 to 90%, noncondensing |
| Max. wet bulb temperature | 28°C (82°F) |
| Min. dew point temperature | 2°C (36°F) |
| Heat dissipation | 259 kJ (239 Btu/h), nominal |
| Altitude, max. | 2,438 m (8,000 ft) |
| Operating for altitude | 1.8°C per 1,000 m (1°F per 1,000 ft) above sea level |
| **Physical Characteristics** | |
| Q-bus loads | 3.0 ac, 0.5 dc |
| Mounting restrictions | Mounts in two adjacent quad-height Q-bus slots |

**Table 3 KDB50 Specifications**

| | |
|---|---|
| **Performance** | |
| Steady-state throughput | Up to 1.2 Mbyte/s (max.) |
| No. of drives supported | Four, or up to four RA component drives in a storage array |
| **Power Requirements** | |
| Power consumed | 73.6 W (max.) |
| Steady-state current | 10.48 A at 5 Vdc (max.)<br>20 mA at 12 Vdc (max.)<br>300 mA at −2 Vdc (max.)<br>3.12 A at −5.2 Vdc (max.) |
| **Operational Environment** | |
| Temperature range | 10 to 40°C (50 to 104°F) |
| Relative humidity | 10 to 90%, noncondensing |
| Max. wet bulb temperature | 28°C (82°F) |
| Min. dew point temperature | 20°C (36°F) |
| Heat dissipation | 282 kJ/h (268.8 Btu/h), nominal |
| Altitude, max. | 2,400 m (8,000 ft) |
| Operating for altitude | 1.8°C per 1,000 m (1°F per 1,000 ft) above sea level |
| **Physical Characteristics** | |
| Mounting restrictions | Mounts in two adjacent slots in the VAX BI |

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